

Resonant Inelastic X-ray Scattering Study of Ce Compounds

Masamitsu Watanabe, ALS

Ce compounds are very attractive materials due to special electronic and/or chemical properties caused by the $4f$ electrons. It is well known that the $4f$ electrons can behave at times localize or delocalize. Many experimental and theoretical studies have been done to reveal the interesting behaviors of the $4f$ electrons, specifically to investigate the interactions between the $4f$ with the valence electrons.

In our study, the electronic structure of Ce compounds; CeO_2 , CeRh_3 , and $\gamma\text{-Ce}$; have been investigated by means of resonant inelastic soft X-ray scattering spectroscopy (RIXS) excited at a resonant energy range of Ce $3d \rightarrow 4f$ absorption. Polarization dependence of the RIXS presented additional information concerning electronic structures of Ce $4f$ electronic states. In CeO_2 , the Ce $4f \rightarrow 3d$ RIXS spectra are interpreted as electronic states hybridized between $4f^0$ and $4f^1\bar{\nu}$ states. Here the $\bar{\nu}$ shows one-hole state in the valence band. The RIXS peaks in the spectra are attributed to bonding, nonbonding, and antibonding states between those states. In the other case of an intermetallic compound CeRh_3 , the spectra could not be explained using only the hybridization between $4f^0$ and $4f^1\bar{\nu}$ states. The spectra have large broad inelastic scattering band, especially when the excitation photon energy is set at a satellite peak of Ce $3d \rightarrow 4f$ absorption spectrum. We attribute the origin of the broad inelastic scattering peak to hybridization states involving electron-hole pairs in the valence band.